Missouri Department of Natural Resources
Data Processing Standard

Topic:	Minimum Computer Configurations
Item:	Supplement to Standard A
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See also:	Data Processing Standard B: Software Standards

This Standard was reviewed and approved

by:_____
Jeff Staake, Deputy Director
Missouri Dept. of Natural Resources

on:_____
Date

Rationale for minimum desktop (non-portable) configuration:

1. **800Mhz Pentium III (with MMX and integral 512K L2 cache) computer.** Various other processor speeds and configurations are available, but these systems currently offer the best "bang for the buck" in most cases. Lesser configurations offer considerably less performance but not substantial savings, while higher-end configurations increase in cost more than they increase in performance**.**

   Details: Machines with older Pentium-family are less costly, but their performance running the modern 32-bit bit operating systems is substantially poorer than a Pentium III. Other companies make CPUs (central processor units) other than the Pentium III, but Intel is the market leader with which other companies strive to be compatible. Most motherboards, chipsets, and other components are also designed with Intel Pentium chips in mind. There is always a risk of incompatibilities when using Intel-compatible CPUs from other vendors.

   Processing power may not seem overly important for ordinary word-processing and the like. However, as the department proceeds with the implementation of more client/server applications that are used by a broad base of staff, a high speed processor and adequate memory are crucial for end-user workstations. Why not buy the cheapest system that will work for an individual position today, save some money, and buy a better system when it is needed? Tight budgets mean that the department will have to use computers purchased today for about five years. If we buy systems that only address present needs, the department will not be able to implement the many new applications that are part of the department's Information Strategic Plan (ISP) because the low-end workstations won't run them effectively. Buying at the mid-point rather than the low or high-end also helps postpone the inevitable obsolescence of the computer while keeping costs reasonable.

2. **256MB of RAM.** While modern operating systems including Windows NT will technically function with much less, 256MB of RAM is the practical amount of RAM needed for applications which the department is or will be implementing during the lifecycle of new systems.

   Details: Having enough RAM (Random Access Memory) is as crucial to performance as a high-speed processor. Having insufficient RAM can slow performance of even the fastest machine to a crawl. Any system that wasn't purchased with enough RAM

would need to be upgraded later. While memory itself has gotten cheap, the labor necessary to upgrade systems is still costly and will continue to be. With RAM, more is always better. Increasing to larger amounts of RAM may or may not provide a further performance boost depending upon the applications used and the level of multi-tasking needed.

3. **20.0GB EIDE hard drive that supports Ultra ATA transfers.** Hard drive space is always at a premium, and very high-capacity, very fast hard drives have gotten very cheap.

   Details: The price difference between the smallest hard drives that are unlikely to be adequate are less than $50 cheaper than larger drives that store much more and transfer data more quickly. Upgrading hard drives later is more time-consuming than upgrading memory, and the associated labor costs are even higher. Even larger hard drives are readily available as upgrades, and adding a second hard drive at purchase time for increased capacity won't typically be necessary for most customers. EIDE (Enhanced Integrated Drive Electronics) type drives are quite fast and adequate for the needs of almost all customers. The latest Ultra-ATA enhancement to EIDE doubles bandwidth between the drive and CPU, allowing drives to transfer data as quickly as the read/write heads can manage. SCSI (Small Computer Systems Interface) drives are a must for file servers because of performance enhancements realized when using multiple drives in a system. Performance is unlikely to be perceptibly changed in a desktop computer by choosing SCSI, making the <u>much</u> higher cost hard to justify for most customers.

4. **17" quality monitor (15.9" viewable area typical).** The industry standard monitor is the 17" monitor, which provides good "bang for the buck." 19" monitors are better if they are a good fit for the furniture and the budget. 21" monitors provide even better viewing area, but carry a price premium of $600 or more above that of a 17" monitor.

   Details: Computer displays, or monitors, are often taken for granted when purchasing a computer. However, with the exception of sound the monitor is responsible for delivering all information to the user. One analogy is to compare the monitor to the windshield on a car, because the windshield supplies the critical information to the driver that is necessary to use the car. If cars offered an option to buy a windshield that had 1/3 less viewing area or used a cheaper glass that made the road look slightly fuzzier, we wouldn't buy it. Likewise, we shouldn't buy monitors that force customers to stare at small screens or screens with blurry or otherwise poor quality images. The best monitors use an aperture-grill or slot-mask picture-tube technology that results in better contrast, brightness, clarity, and screen flatness than cheaper shadow-mask monitors. All these factors result in improved image quality. Such monitors often bear descriptions such as Trinitron, Vivitron, or other "-tron" variations. Orders which include low-quality monitors will not be approved, regardless of screen size.

5. **16MB AGP graphics accelerator.** The latest high-performance video acceleration technology, introduced with the Pentium II chipsets, is Accelerated Graphics Port (AGP). AGP graphics cards not only provide better performance for 3D applications like GIS modeling, the way they separate video data from other data on the system "bus" helps boost system performance regardless of the task.

   Details: Today, 2D acceleration is the main form of graphics acceleration that matters for the average customer. However, more applications are appearing that rely upon 3D and video, and even more are under development. As such, if a video

card is purchased that doesn't accelerate all these, future performance will suffer. Performance may be poor enough that the video card would eventually have to be replaced. As with most other upgrades, the cost of the labor involved makes upgrading more unattractive than does the cost of the new part. AGP enhances performance using traditional acceleration, plus it uses a separate high speed video bus instead of sharing the PCI bus..

6. **Windows NT Workstation software version 4.0.** Of the many different operating systems available, NT Workstation is the one that best fits both where DNR is today and where we are trying to go. It offers superb reliability, flexibility, security, efficient networking (including full Internet support), and widespread industry support. Most importantly, it is a true 32-bit OS (Operating System) with a clear future, and the most likely desktop operating system to still be viable in three to five years.

   Details: Many different operating systems are in use throughout DNR. They each have their positive and negative aspects. Unfortunately, as MIS and the agency in general are called upon to do more and more through technology, the differences (i.e. the lack of standards) makes the implementation of new systems ever more difficult. Each system must be developed with each OS in mind, tested with each OS, have instructions written for installation and support on each OS, and so forth. All DNR employees can best be served by standardizing in many areas, including the desktop OS. NT Workstation is the best strategic standard for the reasons listed above and many others.

   A few key considerations for a "strategic" standard have to be longevity and third-party support. Longevity is important because you want the standard you choose today to still be around next year, in three years, and hopefully beyond. Otherwise we will continually be implementing new standards. NT Workstation is Microsoft's strategic OS. Windows 95 is marketed as an OS mainly for the home and portables, and cannot compete in an office with the reliability and security of NT. Minor upgrades to Windows 95, called Windows 98 and Windows ME, are available, but beyond that all versions of Windows will be based on NT. IBM's OS/2 Warp is a high-quality operating system from a technical standpoint, but IBM has already stated that further development of Warp as a desktop OS is unlikely. Third-party support is important because the company that wrote the OS can't possibly offer every conceivable software category a customer might need. Good third-party support makes it much more likely that software a customer wants to utilize will run on their OS. Almost all applications written for Windows 3.x and Windows 95 will also run on Windows NT. Microsoft requires applications to run on both Windows NT and Windows 95 before they can receive the "Windows 95 approved" logo. This ensures that new Windows applications will run on NT. Third-party support is OS/2's major drawback. There are not a substantial number of vendors writing OS/2 programs today, and even fewer new projects are being announced. To make matters worse, programs written for Windows 95 and NT will not run on OS/2. Most new applications written today are designed for 95 and NT. As a result, it will become harder and harder to find modern applications for OS/2.

7. **Microsoft Office 97 Professional software suite.** Of the different office suites available, Microsoft Office is the one that best fits DNR's current and anticipated future needs. All of the major suites offer ease of use, good performance, flexibility, and other positive features. However, Microsoft Office is the suite most compatible with what both federal and other Missouri state government agencies are using. It also integrates very well with the recommended operating system, Windows NT Workstation

version 4.0; largely because Microsoft makes both products. Most importantly, it is a suite with a clear future, and the most likely office suite to still be viable in three to five years.

Details: Many different office applications are in use throughout DNR. In some cases applications are purchased and used as integrated suites; In others they are not. Each suite and each individual office application such as the word processor have their positive and negative aspects. Unfortunately, as MIS and the agency in general are called upon to do more and more through technology, the differences (i.e. the lack of standards) make the implementation of new systems ever more difficult. This is much the same issue as with operating systems. Many systems must be developed with each office suite and individual office applications in mind, tested with each office suite and individual office applications, have instructions written for installation and support on each suite and application, and so forth. DNR as a whole and MIS customers can be best served by standardizing in many areas, including the office suite. Microsoft Office 97 Professional is the best strategic standard for the reasons listed above and many others.

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While Office 2000 has been released, and a newer version of Office is in the works, the department has been very satisfied overall with Office 97, and there is little need to upgrade at this time that would justify the expense.

8. **PCI Token-Ring 16/4Mbps network card.** For those machines that will communicate directly with DNR's network, a token-ring card capable of both 16Mbps (MegaBits Per Second) and 4Mbps speeds is a must.

Details: A new token-ring card built to make use of the fast PCI (Peripheral Component Interconnect) bus that all Pentium-based computers include will perform faster and more efficiently than a card built for the aging ISA (Industry Standard Architecture) bus. If an ISA-bus style 16/4Mbps token-ring card from an older computer is available, it may be substituted here to reduce costs; albeit with some loss of performance. The department is preparing a multi-year project to move from

token-ring to Ethernet, but until each location is converted, token-ring will still be required.

9. **8X CD-ROM drive.** High-speed CD-ROM drives are now standard on almost all new computers. Since much software, including current operating systems, require a CD-ROM drive for installation, a CD-ROM drive is a must.

   Details: 8X (8 times) refers to the speed of the drive, or 8 times the speed of the first CD-ROM drives. Everything from 4X to 50x drives are currently available, with any of these being sufficient for most customers. Speed claims much beyond 8x rarely translate to substantial improvements in real-world performance. The best bet is usually to stay with whatever the computer maker includes in their basic system, provided it is at least 8X. The "bundled" CD-ROM drive is typically a good blend of speed, price, and quality. Some vendors will offer a CD-ROM (re)writer in place of a simple CD-ROM drive for a small upgrade fee. If the ability to create CDs is important to you, you might consider this option.

10. **Sound card and speakers.** Sounds cards, from basic 16-bit sound-blaster compatible units to high-end wave-table synthesis models, can be beneficial for multimedia applications for some customers. The industry, and especially Microsoft, has near-term goals to make both speech recognition and voice security key features in everyday software. Considering this and the low cost of a basic sound option, it is wise to purchase new systems with sound.

    Details: Most customers would like to have sound on their own desktop system. It allows for playback of audio CDs, provides distinctively different sounds when events occur such as the arrival of new e-mail, and generally makes for a more entertaining computing experience. Unfortunately, many programs find themselves asking if the cost can be justified. For many customers, the answer is that the cost cannot always be justified by today's needs. However, if multimedia applications such as video conferencing, computer-based voice mail, speech recognition, voice security, or even as yet undeveloped applications for sound become beneficial business tools in the next few years, the additional expense at time of purchase may turn out to be a wise investment. Sound cards can be added later, but as with other hardware upgrades the labor costs to install the upgrade usually exceed the cost of the part. Sound card installations can also be particularly complex when the card and its software weren't designed for that particular type of computer, and it is usually difficult to find an exact match once the computer is a year or more old. If funding is available, it may be wisest to purchase the sound card with the computer system and avoid upgrade difficulties in the future.

11. **Unterruptible Power Supply [UPS] to protect PC (Recommended but optional).** Newer computers use power supplies that are "always on", making systems much more susceptible to even minor power fluctuations. It doesn't require a complete power failure or huge power spike to damage equipment. A $99 UPS is inexpensive insurance to protect the investment in the computer, and minimize staff time lost due to momentary power interruptions and power-induced equipment failures.

12. **Iomega Zip Drive or other removable media device for off-line storage/backup (Recommended but optional).** Floppy disks are no longer a very practical means for backing up, archiving, or sharing data. Data sets, graphic images, and software components have grown so large that 1.5MB of storage doesn't begin to address real storage needs. Computer networks and centralized file servers and backup systems reduce the need for off-line storage in the modern office, but do not

always eliminate the need completely – especially in the smaller remote offices without robust file servers or high speed communication lines.

Details: Iomega Zip disks hold about 100MB (or 250MB) of data per cartridge, at a reasonable cost per megabyte. They are substantially faster than floppy disks, though not quite as fast as hard disks. The parallel-port-only models are extremely slow, and should be avoided unless drive portability is the primary purchasing factor. Both IDE and SCSI models perform well. There are many other brands, media formats, and capacities available as well. Everything from 20MB to 4.7GB per media in random-access storage, and 2 to 10GB per media or more for tape. Tape media is generally considered suitable only for backups.

Zip drives are already in use in many areas throughout the department. If the ability to share data with other Zip users is important, this should be considered.

If media is needed that can be read in virtually any modern computer, CDR (Compact Disk Recordable) technology should be considered. CDR isn't very expensive anymore, and works well on a modern multipurpose workstation. It isn't the fastest solution, and isn't for the faint of heart due to its write-only nature. However, the media are very cheap ($1.00 or less in bulk for 650MB disks), and can be read in any CD-ROM drive. They also hold up better over time than most other electronic storage media. CDRW is a slightly more expensive variation which can also use much more expensive disks (about $15.00 each) that can be erased and re-written. However, these re-writable disks cannot be read by many older CD-ROM drives.

13. **V.90 56Kbps or faster MODEM (Optional).** Most non-portable computer have no requirement for a MODEM on DNR's network, because of the ability to access the Internet without using a MODEM.

Details: If a customer's new computer requires a MODEM, buying an internal MODEM with the system is usually an inexpensive upgrade. Software MODEMs or "Win" MODEMs should generally be avoided, since these rely upon the main CPU for processing. This impacts overall system performance, especially for Java applets, leads to increased driver and operating system compatibility issues, and is generally not worth the minimal cost savings. Many DNR customers have only required MODEMs to access the Internet. A network connection to the Internet for DNR has been implemented that eliminates the need for most customers who buy new systems to connect to the Internet using MODEMs. The V.90 protocol is the current communications standard widely supported by Internet Service Providers and computer suppliers.

With Internet communications becoming ever more pervasive, there is now a limited number of computer services and businesses that require anything beyond a connection to the Internet for access. With DNR's network connection to the Internet, all DNR staff who have (a) adequate hardware and software, (b) a network connection, and (c) supervisory approval, are able to get Internet access through the network. This should satisfy most requirements for remote communications. In those cases where it doesn't, MIS could also consider implementation of a "Networked MODEM Dial-Out Pool" if there were a need. Such a setup would allow networked computers to share a MODEM over the network much like printers can already be shared. This would allow divisions to greatly reduce their number of MODEM connections and the telephone charges that go with them. It would also reduce the potential security risks present with desktop computers directly connected to a MODEM and the network at the same time.

14. **Full tower or desktop case (Optional).** Many vendors now ship "mini-tower" systems by default. For an end-user workstation, case style is strictly a customer preference. Other options are often available at minimal or no added cost. However, it is important to decide whether a desktop or some sort of tower case is preferred before the order is placed.

    Details: CD-ROM drives often will not work if the computer system is placed on its side. Therefore, it is not practical to stand a desktop case on its end or lay a tower case flat once the machine arrives. It is imperative to make the decision about the case style up-front.

15. **Three year mail-in warranty on all parts.** New computers are generally quite reliable. Nevertheless, components do fail. Typical warranties for desktops include a minimum of three years during which defective parts may be mailed in for replacement, and unlimited toll-free telephone technical support for hardware problems. If such warranty coverage is an extra-cost option, it may well be worth adding.

    Details: Desktop computer manufacturers typically have an easier time maintaining replacement parts for their systems than portable computer manufacturers. This is largely because radically new models are introduced less often, parts are often interchangeable between models, and the parts are less expensive to keep on hand. Having a warranty or maintenance contract can provide extra protection against getting stuck with a desktop that cannot be repaired. Good warranties and maintenance contracts will even require the manufacturer to provide a comparable replacement system if a computer cannot be fixed. However, because desktop computer parts are often interchangeable, it is unusual for even a five year old desktop computer to be irreparable.

    Some companies will not let you buy extended warranty coverage except at the time the computer is purchased. Maintenance contracts for desktops are usually available. Repair costs for desktops when there is no warranty or maintenance coverage will typically be one hundred dollars or more, with on-site service being more expensive than carry-in (i.e. where the computer is taken to a repair depot by the customer). Retaining warranty or maintenance coverage for the useful life of the desktop is generally cost effective and is recommended. For an additional fee, some companies will also offer "VIP" or "Gold" warranty upgrades that feature benefits beyond the standard warranty. These vary widely in what benefits they offer. Of course, any conveniences must be weighed against the added cost.

    Many manufacturers also offer on-site service as an extra cost option. However, in many cases, the customer still must work with the technical support department by phone to determine the cause of the problem, must contact the "on-site service provider" when the replacement parts arrive by mail, return the defective parts by mail, and so on. If this is the type of on-site support offered, one must consider whether it is worth the cost simply to have someone open the computer's case and replace the parts. If the technical expertise is readily available to perform parts replacements, and such tasks won't interfere with other work, it may be as easy to perform repairs in-house. If no such expertise is available or if these resources are already overtaxed, such on-site service may be a wise investment. Full on-site support, where a technician comes on-site to determine the cause of the problem, obtains the needed parts, replaces the parts, and handles returning any defective parts, can result in a significant time savings for the customer and is most convenient. Unfortunately, this level of support is also very expensive for vendors to offer and this cost is usually passed on to the customer.

Rationale for minimum notebook (portable) configuration:

1. **700Mhz Pentium III (with MMX and integral 512K L2 cache) computer.** Many other speeds and configurations are also available. 700Mhz was chosen as a minimum because slower systems were only marginally less expensive and are rapidly being discontinued.

   Details: Processing power may not seem overly important for ordinary word-processing and the like. However, as the department proceeds with the implementation of more client/server applications that are used by a broad base of staff, a high speed processor and adequate memory will be crucial for end-user workstations. Why not buy the cheapest system that will work for an individual position today, save some money, and buy a better system when it is needed? Tight budgets mean that the department will have to use computers purchased today for about five years. If we buy systems that only address present needs, the department will not be able to implement the many new applications that are part of the department's Information Strategic Plan (ISP) because the low-end workstations won't run them effectively. Buying at the mid-point rather than the low or high-end also helps postpone the inevitable obsolescence of the computer while keeping costs reasonable.

2. **128MB of RAM.** Since new portables are likely to use Windows 2000 eventually and ship with Windows NT 4.0 installed today, adequate memory must be included.

   Details: Having enough RAM (Random Access Memory) is as crucial to performance as a high-speed processor. Having insufficient RAM can slow performance of even the fastest machine to a crawl. Any portable system that wasn't purchased with at least 128MB of RAM would need to be upgraded later. Memory expansion modules for portable computers remain costly, and often one low capacity memory module must be removed in order to install a higher capacity module; This further increases upgrade costs since the amount of memory being removed to accommodate the upgrade must be offset by using an even higher capacity and more costly upgrade module. Labor necessary to upgrade systems is still a factor also. Increasing to larger amounts of RAM may or may not provide a further performance boost depending upon the applications used and the level of multi-tasking needed.

3. **10.0GB EIDE hard drive that supports Ultra ATA transfers.** Hard drive space is always at a premium, and a high capacity hard drive is a must.

   Details: In portable computers, smaller hard drive that may not be adequate to store basic application programs within three years are no longer substantially cheaper than 10.0GB drives that store much more. Upgrading hard drives later in portable computers is costly if an upgrade component is even available one year after purchase. The quick product development cycles in the portable computer market typically make it difficult, or impossible, to find upgrade components such as hard drives soon after system purchase. Labor costs associated with replacing hard drives are also high. Adding a second hard for further increased capacity typically isn't possible. Hard drives larger than 10.0GB are now available for portables as options or even standard equipment, and should be considered if the unit is likely to need more disk storage during its useful life.

4. **13" SVGA active-matrix color display.** None of the displays offered with portable computers quite match the size or brightness of a full-size computer monitor. Still, this

display type represents the general baseline for portable computers and is quiet good for all situations except when using a portable as a full-time desktop computer.

Details: Portable computer displays are based on LCD (Liquid Crystal Display) or similar technologies rather than the CRT (Cathode Ray Tube) technology that desktop monitors use. LCD displays are used in portable computers because of their smaller size, lighter weight, and greatly reduced power needs. Drawbacks often include utilization of larger pixels or dots to form a screen image, leading to a "grainy" image; and lack of brightness, leading to a "washed out" image. Fortunately, LCD screen technology continues to improve, and today's displays are far better than anything sold even a few years ago.

5. **4MB AGP graphics accelerator.** The latest high-performance video acceleration technology, introduced with the Pentium II chipsets, is Accelerated Graphics Port (AGP). AGP graphics cards not only provide better performance for 3D applications like GIS modeling, the way they separate video data from other data on the system "bus" helps boost system performance regardless of the task.

   Details: Today, 2D acceleration is the main form of graphics acceleration that matters for the average customer. However, more applications are appearing that rely upon 3D and video, with even more under development for the future. Therefore, if a video option is purchased that doesn't accelerate all these, future performance will suffer. Performance may be poor enough that the video option would eventually have to be replaced. Unfortunately, the integrated video included with almost all portable computers cannot be upgraded or easily replaced.

6. **Microsoft Windows NT Workstation version 4.0.** Of the many different operating systems available, NT Workstation is the one that best fits both where DNR is today and where we are trying to go. It offers superb reliability, flexibility, security, efficient networking (including full Internet support), and widespread industry support. Most importantly, it is a true 32-bit OS (Operating System) with a clear future, and the most likely desktop operating system to still be viable in three to five years.

   Details: Many different operating systems are in use throughout DNR. They each have their positive and negative aspects. Unfortunately, as MIS and the agency in general are called upon to do more and more through technology, the differences (i.e. the lack of standards) makes the implementation of new systems ever more difficult. Each system must be developed with each OS in mind, tested with each OS, have instructions written for installation and support on each OS, and so forth. All DNR employees can best be served by standardizing in many areas, including the desktop OS. NT Workstation is the best strategic standard for the reasons listed above and many others. Once, NT Workstation was not practical for portable computers because of hardware / software compatibility limitations, but those have largely been overcome.

   A few key considerations for a "strategic" standard have to be longevity and third-party support. Longevity is important because you want the standard you choose today to still be around next year, in three years, and hopefully beyond. Otherwise we will continually be implementing new standards. NT Workstation is Microsoft's strategic OS. Windows 95 is marketed as an OS mainly for the home and portables, and cannot compete in an office with the reliability and security of NT. Minor upgrades to Windows 95, called Windows 98 and Windows ME, are available, but beyond that all versions of Windows will be based on NT. IBM's OS/2 Warp is a high-quality operating system from a technical standpoint, but IBM has already stated that further

development of Warp as a desktop OS is unlikely. Third-party support is important because the company that wrote the OS can't possibly offer every conceivable software category a customer might need. Good third-party support makes it much more likely that software a customer wants to utilize will run on their OS. Almost all applications written for Windows 3.x and Windows 95 will also run on Windows NT. Microsoft requires applications to run on both Windows NT and Windows 95 before they can receive the "Windows 95 approved" logo. This ensures that new Windows applications will run on NT. Third-party support is OS/2's major drawback. There are not a substantial number of vendors writing OS/2 programs today, and even fewer new projects are being announced. To make matters worse, programs written for Windows 95 and NT will not run on OS/2. Most new applications written today are designed for 95 and NT. As a result, it will become harder and harder to find modern applications for OS/2.

7. **Microsoft Office 97 Professional software suite.** Of the different office suites available, Microsoft Office is the one that best fits DNR's current and anticipated future needs. All of the major suites offer ease of use, good performance, flexibility, and other positive features. However, Microsoft Office is the suite most compatible with what both federal and other Missouri state government agencies are using. It also integrates very well with the recommended operating system, Windows NT Workstation version 4.0; largely because Microsoft makes both products. Most importantly, it is a suite with a clear future, and the most likely office suite to still be viable in three to five years.

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market also leads all too often to discontinuation or sale of such product lines. WordPerfect, which is now part of the Corel Suite, has changed owners twice in a few years with rewrites of the software each time, and its future at Corel is still a topic of much speculation.

While Office 2000 has been released, and a newer version of Office is in the works, the department has been very satisfied overall with Office 97, and there is little need to upgrade at this time that would justify the expense.

8. **Token-Ring 16/4Mbps network PC-Card.** For those machines that will communicate directly with DNR's network, a token-ring card capable of both 16Mbps (MegaBits Per Second) and 4Mbps speeds is a must.

   Details: Token-ring PC-Cards have not undergone significant design changes in years. If a token ring PC-Card (previously known as a PCMCIA token-ring card) from an older portable is available, it may usually be substituted in place of a new one. The department is preparing a multi-year project to move from token-ring to Ethernet, but until each location is converted, token-ring will still be required.

9. **8X CD-ROM drive.** High-speed CD-ROM drives are now standard on almost all new computers. Since much software, including current operating systems, require a CD-ROM drive for installation, a CD-ROM drive is a must.

   Details: 8X (8 times) refers to the speed of the drive, or 8 times the speed of the first CD-ROM drives. Everything from 8X to 32x drives are currently available, with any of these being sufficient for most customers. Speed claims much beyond 8x rarely translate to substantial improvements in real-world performance. The best bet is usually to stay with whatever the computer maker includes in their basic system, provided it is at least 8X. The "bundled" CD-ROM drive is typically a good blend of speed, price, and quality. Some of the latest CD-ROM drives support reading CDRW media as well as CDR media. If this is important to you, be sure to verify that a given drive offers this capability.

10. **Integrated sound and speakers.** Sound systems, from basic 16-bit sound-blaster compatible units to high-end wave-table synthesis models, can be beneficial for multimedia applications for many customers with portables. Portables are often used for presentations which are multimedia based. The industry has near-term goals to make both speech recognition and voice security key features in everyday software. Considering this and the low cost of a basic sound option, it is wise to purchase new systems with sound, and is usually included at no added cost.

    Details: Most customers would like to have sound on their own system. It allows for playback of audio CDs, provides distinctively different sounds when events occur such as the arrival of new e-mail, and generally makes for a more entertaining computing experience. Unfortunately, many programs find themselves asking if the cost can be justified. For many customers, the answer is that the cost cannot always be justified by today's needs. However, if multimedia applications such as video conferencing, computer-based voice mail, speech recognition, voice security, or even as yet undeveloped applications for sound become beneficial business tools in the next few years, the additional expense at time of purchase may turn out to be a wise investment. Sound often cannot be easily added later to portables that don't include it. If funding is available, it may be wisest to purchase the sound option with the computer system and avoid upgrade difficulties in the future. On many portables sound is "bundled", eliminating the need to make this decision.

11. **V.90 56Kbps or faster PC-Card MODEM (Recommended but optional).** If a customer's new computer requires a MODEM, buying a PC-Card (previously known as PCMCIA) 56K or faster MODEM with the system is usually an inexpensive upgrade. With a portable computer, it is more likely a MODEM will be beneficial because of the possibility of remotely checking e-mail and otherwise communicating with the DNR network and the Internet. The V.90 protocol is currently preferred because it is most widely supported by Internet Service Providers and computer suppliers.

    Details: Since portables will normally only be purchased in those cases where they will be used outside the office, it usually makes sense to equip them with MODEMs for remote communications such as checking e-mail. If this is considered unlikely for the particular application, a PC-Card MODEM can easily be added later to a portable computer. Also, because PC-Cards are standard across the industry, it is likely that PC-Card MODEMs will still be available for several years as add-on upgrades.

12. **Iomega Zip Drive or other removable media device for off-line storage/backup (Recommended but optional).** Floppy disks are no longer a very practical means for backing up, archiving, or sharing data. Data sets, graphic images, and software components have grown so large that 1.5MB of storage doesn't begin to address real storage needs. Computer networks and centralized file servers and backup systems reduce the need for off-line storage in the modern office, but do not always eliminate the need completely – especially for portable computers.

    Details: Iomega Zip disks hold about 100MB (or 250MB) of data per cartridge, at a reasonable cost per megabyte. They are substantially faster than floppy disks, though not quite as fast as hard disks. The parallel-port-only models are extremely slow, and should be avoided unless drive portability is the primary purchasing factor. PC-Card attached models perform better. There are many other brands, media formats, and capacities available as well. Everything from 20MB to 4.7GB per media in random-access storage, and 2 to 10GB per media or more for tape. Tape media is generally considered suitable only for backups.

    Zip drives are already in use in many areas throughout the department. If the ability to share data with other Zip users is important, this should be considered.

    If media is needed that can be read in virtually any modern computer, CDR (Compact Disk Recordable) technology should be considered. CDR isn't very expensive anymore, and works well on a modern multipurpose workstation. It isn't the fastest solution, and isn't for the faint of heart due to its write-only nature. However, the media are very cheap ($1.00 or less in bulk for 650MB disks), and can be read in any CD-ROM drive. They also hold up better over time than most other electronic storage media. CDRW is a slightly more expensive variation which can also use much more expensive disks (about $15.00 each) that can be erased and re-written. However, these re-writable disks cannot be read by many older CD-ROM drives.

13. **Surge Suppressor to protect battery charger (Recommended but optional). Unterruptible Power Supply [UPS] recommended when docking with externally powered peripherals.** While portable computers are not as affected by power fluctations as desktop systems, because of their internal batteries, they are still at risk of serious damage from larger power surges, spikes, etc. Inexpensive surge suppressors designed specifically for portable computers are a worthwhile form of protection. When connecting a portable to an external monitor or other powered peripherals, power problems can also reach and damage the portable through these connections. In these cases, a $99 UPS is inexpensive insurance to protect the

investment in the computer, and minimize staff time lost due to power-induced equipment failures.

14. **External monitor (Optional for in-office use).** If a portable computer will be used in the office a significant amount of the time as well as out of the office, an external monitor will provide a display for the portable far superior to the smaller built-in display.

    Details: The industry standard monitor range is the 17" or 19" monitor, and a quality Vivitron unit that provides excellent picture quality is recommended..

15. **External keyboard (Optional for in-office use).** External full-sized keyboards are preferred by many people to the built-in keyboards of most portables. If a portable computer will be used in the office a significant amount of the time as well as out of the office, an external keyboard can be an inexpensive option that makes using the portable more comfortable.

    Details: Most current portables require PS/2-compatible keyboards, such as those sold with most IBM and Gateway systems. Some portables do not allow using an external keyboard and external mouse at the same time; It may be necessary to choose one or the other.

16. **External mouse (Optional for in-office use).** An external mouse is preferred by many people to the built-in pointing devices of many portables. If a portable computer will be used in the office a significant amount of the time as well as out of the office, an external mouse can be an inexpensive option that makes using the portable more comfortable. This is especially true for people who have difficulty using trackballs, pointing sticks, or touchpads.

    Details: Most current portables work best with a PS/2-compatible mouse, such as those sold with most IBM and Gateway systems. Some portables do not allow using an external keyboard and external mouse at the same time; It may be necessary to choose one or the other.

17. **Docking bar or docking station (Optional for in-office use).** Some customers will have an external monitor, keyboard and/or mouse, a printer, or other attachments for their portable when they use it in the office. In such instances, it may be convenient or necessary to connect all these peripherals to the portable using a docking bar or docking station.

    Details: Previously, docking appliances were the only way to connect many peripherals to a portable computer. With current portables, these devices are typically used only to make disconnecting and reconnecting the portable from the various peripherals faster and easier.

18. **Three year mail-in warranty for complete system.** New computers are generally quite reliable. Nevertheless, components do fail. Typical warranties for portables include a minimum of one year during which the system can be mailed in for repair and unlimited toll-free telephone technical support for hardware problems. If such warranty coverage is an extra-cost option, it may well be worth adding. If an option is available to extend the warranty coverage period to three years, purchasing this is highly recommended.

    Details: The special manufacturing methods used to build portable computers requires almost all repairs to be performed at the factory; This is why mailing the whole system off for repair is usually the only service method available.

Unfortunately, most portable computer manufacturers do not maintain large stocks of replacement parts for their systems because they introduce new computer models as often as twice a year. To keep large numbers of spare parts for each of these models would add to their overhead. While this is good business for the companies, it makes it less likely that spare parts will be on hand to repair systems. Having a warranty or maintenance contract provides some protection against getting stuck with a portable that cannot be repaired. Good warranties and maintenance contracts will even require the manufacturer to provide a comparable replacement system if a computer cannot be fixed.

Some companies will not let you buy extended warranty coverage except at the time the portable is purchased. Maintenance contracts for portables are not always offered because of the limited spare parts stocks. Repair costs for portables when there is no warranty or maintenance coverage will typically be several hundred dollars, provided needed replacement parts are even available. Therefore, unless you can readily absorb the cost of any needed repairs or a system replacement, retaining warranty or maintenance coverage for the useful life of the portable whenever possible is recommended. For an additional fee, some companies will also offer "VIP" or "Express" warranty upgrades that feature faster repair times than the standard warranty. These can reduce the downtime caused by a failure from more than a week to two or three days. Of course, this convenience must be weighed against the added cost.